NATIONAL AGRICULTURAL RESEARCH ORGANISATION

FISHERIES RESOURCES RESEARCH INSTITUTE

ANNUAL REPORT 1999/2000

Background

About 20% of Uganda territory is surface water from which 250,000m tons of fish is produced. In addition to fish exports which earned the country US$ 40m in 1996, fish provides 50% of protein diet of the 20m people translating into a per capita consumption of 12kg. It is estimated that fishery related activities employ at least one million people.

Mandate

In order to more realistically project its mandate, the Fisheries Research Institute (FIRI) had its name revised to the Fisheries Resources Research Institute (FIRRI) during the reporting period. FIRI has the mandate "**to promote, undertake and coordinate all aspects of research in fisheries, fish production systems and the water environment, aquaculture and socio-economics while conserving the natural resource base.**

Goal

The goal of FIRRI is to generate and transfer improved technologies and policy recommendations aimed at ensuring sustainable fish production and a healthy environment in which fish is produced.

Objective

Governed by its mandate and the sector/policy framework, FIRRI'S objective in the agricultural modernization strategy is "to increase the quantity, quality and availability of technologies (information), policy advice (recommendations) and methods for the efficient and profitable use of fishery resources that also promote food security while conserving the water environment.

Specific Objectives

The specific objectives of FIRRI are to:

- Generate technology, and provide information and policy recommendations on fish and fish production systems; and,
- Transfer technologies and policy recommendations generated to uptake pathways.

Programmes

The institute has three research programmes namely:

- Limnology and Water Environment
- Capture Fisheries
- Aquaculture

Socio-economic issues are addressed across programmes.

Post-harvest fisheries, once the fourth program at FIRRI was elevated to institute (FOSRI) status, but maintained research linkages with FIRRI.

Staff

FIRRI had 88 NARO appointed staff (Annex I) including 21 research scientists, 15 technicians and other support staff at various levels (boat crew, administration/accounts, library and junior staff). Staff changes are detailed in Annex I.

Collaboration and Linkages

FIRRI collaborated with other NARO institutes and was especially involved in retaining working relationships with FOSRI (previously the post-harvest program under FIRI). Other collaborators included the Uganda Fisheries Resources Department, several departments at Makerere University, the Directorate of Water Development (DWD), National Water and Sewage Cooperation (NWSC), the National Wetlands Program (NWP), and NGOs.

International and regional collaborators included research institutions around Lake Victoria i.e. the Kenya Marine Fisheries Research Institute (KMFRI) in Kenya, and the Tanzania Fisheries Research Institute (TAFIRI). Collaboration on the international scene included the Universities of Waterloo, Florida, Wagenigen and Zurich on fish habitat and water quality studies; Boston, and Leiden on fish taxonomy, and several others involved with student exchanges and supervision of research topics.

Funding

The programmes at FIRRI were financially supported by the Government of Uganda, the World Bank and GEF through the Lake Victoria Environmental Management Project, IDRC, DFID (Aquaculture) and EU (the Lake Victoria Fisheries Research Project). There were also short term studies undertaken through studentships in addition to contractual services rendered to clients such as the AES Nile Power EIA surveys on the Victoria Nile.

Programme Report

Limnology and Water Environment

Research Objectives

The limnology and water environment research activities seek to resolve the environmental basis of and constraints to fishery production. Research in the program generates information on the state and dynamics of the water environment and on its facilitation of and influence on fish productivity.

Constraints addressed

The main constraints addressed by research relate to:
a) changes in physico-chemical features
b) low productivity in some water bodies
c) impact of wetland degradation on fish production and water quality
d) water hyacinth infestation

Research focus

During the period under review activities focussed on:
- The productivity of Lakes Victoria and Kyoga;
- Capacity of wetlands to strip nutrients and pollutants from in-flowing water and their importance as interface fish habitats in lakes; and
- Growth, control and other dynamics of water hyacinth and its ecological and socio-economic impacts on the water environment, fisheries resource and the lake-shore communities.

Achievements

Wetlands

During the period under review, lakeshore wetlands research relied mostly on desk studies – analyses of data sets and write-ups. The influence of the type of vegetation at the shore on fish abundance and changes in sex ratio in the Nile tilapia according to season were among the evaluated aspects. These studies recorded several patterns.

There is a higher biomass of Nile tilapia in habitats closer to lakeshore vegetation (zone I) than in areas only 70m away from the vegetation (zone 2). Also, the size of the fish varies with each lakeshore type (Table 1)

Table 1. Variations in biomass and relative abundance of the Nile tilapia according to size and type of vegetation at the lakeshore or distance from the shore.

Zone I	Water hyacinth	Papyrus	Vossia	Typha	Phragmites
	Percentage of total biomass				
Fish >25cm TL	75	73	43	29	19
15.1 – 25cm	24	26	50	62	58
<15cm	1	1	7	9	22
Tot. biomass ($kg.ha^{-1}$)	22.7	20.0	29.4	32.9	32.4
Zone II					
Fish >25cmTL	43	73	28	54	67
15.1 – 25cm	48	24	62	43	17
<15cm	8	3	10	3	16
Tot. biomass ($kg.ha^{-1}$)	7.7	5.8	27.7	27.8	4.0
No experiments conducted	22	32	12	20	15

Data sets on reproductive biology of the Nile tilapia reveal the following practical aspects:

- In the general fish stock of the Nile tilapia, the sex ratio is 1:1
- Depending upon the type of vegetation of the shore, the sex ratio varies significantly. For example, female fish are more associated with *Vossia* and *Phragmites* – dominated lakeshore wetland habitats.
- The sex ratio in the vegetation dominated habitats also varies according to season.
- The patterns are elaborated in Table 2.

Table 2. Sex ratio distribution in the Nile tilapia of Lake Victoria according to habitat and reason.

Season/ habitat	Males	Females	Sex ratio	% male
Papyrus habitat				
Dec – March	18	13	1.4:1.0	58
Mar – June	37	40	1.0:1.1	48
July – Sept.	22	15	1.5:1.0	60
Sept – Nov.	11	4	2.7:1.0	73
Total	**88**	**72**	**1.2:1.0**	**55**
Water hyacinth habitat				
Dec – March	7	8	1.0:1.4	47
Mar – June	28	22	1.3:1.0	56
July – Sept.	13	12	1.1:1.0	52
Sept – Nov.	16	15	1.2:1.0	55
Total	**66**	**57**	**1.2:1.0**	**54**
Vossia (Hippograss) habitat				
Dec – March	14	5	2.8:1.0	74
Mar – June	4	7	1.0:1.8	36
July – Sept.	3	2	1.5:1.0	60
Sept – Nov.	2	13	1.0:6.5	13
Total	**23**	**27**	**1.0:1.2**	**46**
Typha habitat				
Dec – March	7	12	1.0:1.7	37
Mar – June	35	35	1.0:1.0	50
July – Sept.	5	3	1.7:1.0	67
Sept – Nov.	7	12	1.0:1.7	37
Total	**54**	**62**	**1.0:1.2**	**47**
Phragmites (reeds) habitat				
Dec – March	5	8	1.0:1.6	38
Mar – June	7	11	1.0:1.6	39
July – Sept.	6	5	1.2:1.0	55
Sept – Nov.	1	7	1.0:7.0	14
Total	18	31	1.0:1.7	37
Tot. all habitats (Pop. As a whole)	499	498	1.0:1.0	50

The FIRI-SWISS Ecotone Project which expired at the end of 1998 was an interdisciplinary and development oriented activity carried out by Fisheries Resources Research Institute and the University of Zurich. The project through Phase I (1994-96) aimed at identifying options for sustainable use and management of Jinja's urban wetlands of Kirinya west – Loco; Kirinya east –Walukuba; Masese and Bundumbuli, all lying along the eastern shores of Lake Victoria. Stakeholders involved included Jinja Municipal Council (JMC), Jinja's industrial sector, National Wetlands Programme, plant gatherers and healers, farmers, fishermen, women groups, National Water and Sewage Corporation (NWSC), Makerere University Institute of Social research (MISR), Fisheries Resources Research Institute (FIRRI), University of Zurich, Switzerland and Basle Institute of Technology.

Analysis of results from the study (1997/98) on industrial pollutants into Kirinya East – Loco urban wetland acting as a natural sewage treatment plant for urban, industrial, domestic sewage and surface run-off identified pollution 'hot spots' (Table 3).

Table 3. Major potential pollution sources

Point sources	Active nutrients	Status
Gomba & Agro-marine Fishing Industries Ltd.	Phosphorus, organic carbon, organic nitrogen NH4/NO3)	Fish filleting
Kengrow Industries Ltd.	Organic carbon	Food (oil) & soap
Leather Industries of Uganda	Chromium metal	Tannery (Leather)
Chillington Co. Ltd.	Copper, lead, manganese, nickel	Metallurgy (hoes)
Steel Rolling Mills Ltd	Nickel	Metallurgy (Iron rods & bars
NWSC Final maturation pond	Phosphorus, organic carbon, organic nitrogen (NH4)	Lagoon

Water hyacinth research

Several waves of resurgence by dwarf water hyacinth dominated by the bulbous type occurred in Lake Victoria but were repeatedly suppressed by the effects of biological control weevils. Experiments monitoring the ecological effects due to sunken biomass of water hyacinth in the sheltered bays of Thruston and Waiya continued. The influence of the biomass on water quality, biodiversity and fisheries will probably be long term. Data analysis is underway and results will be published elsewhere as they emerge.

Water hyacinth remained under control confined to the channels to landing sites through fringing papyrus. Water hyacinth fringing Rivers Nile and Kagera persisted and was a constant source of biomass into lakes Kyoga and Victoria, respectively. The impact of the input into Lake Kyoga was rated insignificant in socio-economic terms. The biomass from River Kagera is fragmented by wave action in Lake Victoria and eventually sinks to the lake bottom due to lack of suitable sheltered nursery sites. Continuous accumulation of water hyacinth debris in Lake Victoria is probably detrimental to the ecology of benthic fauna and to the nutrient balance of the lake.

The extensive flooding of low-lying shores of Lakes Kyoga and Kwania due to El Nino rains and the subsequent blockage by displaced sudds at the River Nile outflow persisted through most 0of the year. The rising lake levels translocated extensive shoreline wetlands plus the hippograss-dominated succession that replaced stationary water hyacinth. A large number of sudds roamed the two lakes inflicting severe socio-economic loss in terms of missing fishing gears and unused fishing time due to reluctance to risk gear.

A new equipment – the Sea Bird Profiler which automatically measures temperature, dissolved oxygen, conductivity, chlorophyll and depth was deployed abroad RV Ibis. Simultaneous fish stock assessment studies benefited from having added limnological evaluation during the cruises.

Lake Productivity mechanisms

Aquatic invertebrates live in the water column (pelagic environment), in bottom mud (sediments) or in roots of macrophytes (water plants).

The aquatic invertebrates research addresses species composition, diversity, abundance in relation to fishery production in the different lakes and rivers. The invertebrates are an ecologically important biological component of water bodies largely due to their role in fish nutrition, nutrient regeneration and environmental monitoring.

During stakeholders workshops held for lakes Victoria and Kyoga and Minor lakes of Western Uganda, a number of constraints including declining fishery yields and rampant aquatic environmental degradation were submitted to FIRRI for investigation. Among the priority activities carried out to address these constraints were field investigations into the ecology of invertebrate organisms associated with different water bodies and their potential contribution to fishery production.

During the year under review, field research trips were undertaken to Lake Kyoga and Lake Nabugabo and their associated satellite lakes, Kooki lakes, Lake Wamala and Kabaka's lake to River Sio and the Victoria Nile. Both micro- invertebrates (minute organisms up to 1.5mm body size; (seen only with help of a microscope) and macro- invertebrates (larger organisms seen with naked eye) were investigated.

Findings

Among the micro-invertebrates

- Cyclopoid copepods were numerically dominant in all the water bodies investigated and was the most commonly occurring organisms in fish larvae and juvenile fishes.
- Rotifers were the most diverse group comprising 24 out of the total of 40 micro-invertebrate species encountered
- Cladocera (water fleas) were a generally rare group with the exception of a single species *Moina micrura*, which occurred in all water bodies. Rarity of these organisms may relate to consumption by fish predators besides environmental causes.

- Lakes Bisina and Kyoga (Iyingo area) had the highest species diversity in the Kyoga basin lakes
- The total number of organisms was higher in offshore compared to inshore waters

Among macro-invertebrates

- Dipteran larvae (juveniles) and Oligochaete worms were the most widely distributed groups; occurring in sediments of all the lakes investigated
- Total number of organisms was generally higher in offshore compared to inshore sediments
- Areas/sites with sandy/stony bottom had higher diversity and abundance of macro-invertebrates than soft mud bottoms
- Aquatic macrophytes supported higher diversity of organisms than bottom sediments in all water bodies investigated
- *Bulinus* and *Biomphalaria*, snail vectors of Bilharzia commonly occurred in areas with aquatic macrophytes especially in water hyacinth-infested areas
- Nabugabo lakes were devoid of Bilharzia snails; a fact which may relate to their mineral content
- Lake Kyoga and associated satellite lakes generally had soft mud bottoms that supported lower densities of organisms than other water bodies
- River Sio area, characterised by a silty bottom had very low densities of organisms probably due to low organic content
- The Victoria Nile registered the highest diversity of macro-invertebrates and all organisms recovered showed strong adaptation to clinging on to fixed objects such as stones presumably to cope with a fast-running water environment
- Most of the macro-invertebrates encountered in these field surveys are of common occurrence in diets of fishes including some commercially important fish species such as the Mputa, Mamba/Kamongo, catfishes, Momyrids etc. Therefore their occurrence and abundance contribute to the fishery production in general.

Capture Fisheries

Research Objectives

The Capture Fisheries Programme aims at generating a knowledge base on fish stocks, the biology and ecology of different species with a view to providing recommendations and policy guidelines on sustainable exploitation patterns.

Constraints addressed

Key constraints addressed include:
- Declining catches and fish species diversity
- Inadequate information on fish stocks
- Use of destructive fishing gears and methods
- Fish production in the minor lakes of western Uganda

Research Focus

Effort was concentrated on:

- Fish stock assessment in Lake Victoria
- Lake Kyoga fisheries and the increasing importance of Mukene
- Lake Wamala
- The biology and ecology of Mukene, Nile tilapia, *Brycinus* and *Haplochromis*
- Biodiversity issues

Achievements

This section includes activities carried out under the EU-LVFRP (Lake Victoria Fisheries Research Project) and LVEMP (Lake Victoria Environmental Management Project) workplans, and activities on other lakes.

Lake Victoria

Lake Victoria Fisheries Research Project

Background

Lake Victoria is currently the most productive lake in Uganda and contributes over 50% of the national fish production. The lake contributes significantly to the Uganda development objective of poverty eradication by providing food, employment and export earnings. It is the source of virtually all the fish that is currently factory processed and exported from Uganda to the tune of about US$ 50 million annually. There are, however, a number of factors that threaten this value: the current heavy investments in the fishery have been done without adequate knowledge of the fish stocks; the environment of the lake has changed drastically over the last three decades to the extent that most of the lake is no longer able to support fish life due to lack of oxygen and there are symptoms of excessive nutrient inputs; the processes that lead to production of fish have also changed. The EU-LVFRP addresses some of these issues so as to prevent potential collapse in the fishery

Objectives

The project aims at providing technologies, methods and advice for:

- sustainable exploitation and management of the fish stocks;
- understanding the capacity of the lake to produce fish;
- prevention of degradation of the lake's habitat;
- management and utilization of the fisheries resources with greater community participation.

During the period 1 July 1999 to 30 June 2000, the project undertook a number of activities which included the following:

- Lake cruises for bottom trawling exercises.
- Experimental multimesh gillnetting.
- Catch effort studies.
- Socio-economics studies
- Attendance and participation in workshops and conferences.
- Management and other meetings.
- Training.
- Procurement of equipment.

Lake cruises using Research Vessel IBIS

During the reporting period monthly cruises were taken monthly except for the months of October 1999 and January 2000. Five cruises were made to Zone I (between Tanzania/Uganda border and Bukakata) in July and September 1999 and February, March and April 2000 while four cruises were made to zone II (between Bukakata and Kiyindi) in September and November 1999 and March and May 2000; four cruises were made in August and December 1999 and February and June 2000 to zone III (between Kiyindi and Uganda/Kenya border). During the cruises an assessment of the fish stocks of the lake was carried out to determine the composition and population structure of the fish species, the abundance, distribution and biomass of the fish available for harvesting and the biology of the major fish species was undertaken. Water quality parameters (e.g. Oxygen, temperature, pH, conductivity) were also taken to determine the suitability of the water for fish production.

Experimental gillnetting

Multimesh gillnets, rigged to sample the water columns from surface to lake bed, and covering all depths and full size ranges of fish (of Nile perch in particular), were set in areas being bottom trawled to complement the information obtained through bottom trawl surveys and in the shallow inshore and non-trawlable areas.

Multimesh gillnet surveys were conducted in Lake Victoria West during September and November 1999 while the surveys in Lake Victoria Central were conducted during July and October 1999 and May 2000; only one survey was conducted in April 2000 in Lake Victoria East.

The information obtained from these surveys included species composition and distribution by mesh size and water depth, relative abundance, and population structure. During the surveys information was also collected on the exploitation levels based on the fish landed by the fishermen.

Catch effort studies on Lake Victoria

Catch effort studies aim at establishing the current status of the artisanal fisheries of lake Victoria. Field catch effort surveys have been conducted monthly from September 1999 to June 2000 at 22 selected fish landing sites. These landing sites were selected in three zones of the lake; Nine landing sites in the Eastern zone, six landing sites in the central zone and seven landing sites in the western zone. They represent the three major artisanal fisheries of the lake i.e. Nile perch, Nile tilapia and Mukene on the mainland shore line, mid offshore islands and far offshore islands. Ten-day surveys were carried out at the selected fish landing sites in each of the three zones once in every three months during the period July 1999 - June 2000. Information collected included the type, size and mode of propulsion of fishing boats; the fishing gear composition (type, size and number) and the fish catch composition. Monthly collection of these data is continuing up to June 2001.

The surveys covered fish catches of gillnets, long lines, hand lines, beach seines, cast nets for the large fish species and Lampala net for Mukene.

1. Gillnets were the most prominent fishing gear for Nile perch and Nile tilapia in all landing beaches surveyed. The method of operation of gillnets showed a strong relationship with the type, size and mode of operation of boat; the targeted fish species, fish size, and fishing grounds.

(a) Active operation of gillnets by various methods that force fish into the net. This was the prominent mode of operation by fishers targeting Nile tilapia in shallow inshore areas. These fishers mainly used small flat-bottomed planked canoes.
(b) Passive gillnets (i.e. set at one site overnight) which targeted small Nile perch. Medium size 5-8 m long manually powered Ssese canoes were the main craft.
(c) Gillnets operated as drift nets, which targeted large Nile perch. Large motorised boats were the major craft.

A continuous reduction in the mesh size of gillnets from $\geq$152 mm to either 140 or 127 mm was observed at several landing sites among boats that operate gillnets as drift nets. Nile perch between 40 and 50 cm total length dominated the catch among these boats. Reduction of mesh size could be due to either a decline in catches of larger Nile perch or market preference for smaller Nile perch

3. Most of Nile perch caught with hooks in the long line and hand line fishery were large, > 50cm Total length, suitable for harvest.

4. Boats using either small gill nets of mesh sizes between 76 and 127-mm beach seines landed substantial quantities of small Nile perch between 15 and 40 cm total length. The small fish have a ready market at the lading sites where they are processed by salting or sun drying.

5. Mukene landed in the far offshore islands were of bigger size than that landed on or near the mainland although all the Lampala nets used were of 5 mm mesh size. This can be attributed the low fishing intensity in the far offshore waters.

Conclusions/Recommendations

1. Cropping of small juvenile Nile perch is on the increase and efforts should be made to reduce it.

2. Further development of the Mukene fishery should focus on the far offshore waters, which are now lightly fished.

Socio-economics studies

The Socio-economics component of the project concentrated on Co-Management studies during the reporting period. Details of the studies findings are contained in a separate section of this report.

Workshops/Conferences

The project personnel participated in the various workshops organized to discuss and disseminate the research findings. These included:

- A workshop for the Fisheries Data Working Group (FIDAWOG) held on 16-20 August 1999 in Kisumu, Kenya.
- Regional Workshop on "Research Findings on Lake Victoria" held on 21-22 February 2000 in Mwanza, Tanzania.
- LVFRP Planning Workshop held on 27 February – 3 March 2000 in Kisumu, Kenya, to discuss the progress of the progress and plan for the remaining period of the project.
- Lake Victoria 2000 International Conference held on 15-19 May 2000 in Jinja, Uganda, to discuss the findings of research work on Lake Victoria.

Meetings

During the reporting period a number meetings were held to assess the progress of the project and also harmonize the implementation of the scheduled project activities. These meetings included:

- 2-3 December 1999: LVFRP Management Committee meeting (8^{th}), Mwanza, Tanzania.
- 1-2 June 2000: LVFRP Management Committee meeting (9^{th}), Jinja, Uganda.
- Lake Victoria Frame survey 2000 Task force meetings; 9-11 January 2000 in Dar-es-Salaam, Tanzania; 23-26 January 2000 in Kisumu, Kenya; 7-11 February 2000 in Dar-es-Salaam, Tanzania.

The LVFRP Management Committee is composed of the 3 Directors/Commissioner of Fisheries Departments and the 3 Directors/Director General of Fisheries Research Institutes in the three riparian countries of Kenya, Tanzania and Uganda. The Committee meets once every six months, hence, two meetings were held during this period.

Training

The three Ph.D candidates (Mr L. Muhoozi and Mrs Rhoda Tumwebaze with the University of Hull in UK; Mr J.O. Okaronon with the University of Nairobi) continued with the field data collection. The Socio-economics M.Sc candidate (Mr M. Kyangwa with Moi University in Kenya) continued with the course work/field data collection.

Some other training activities under the project included the following:

- 23 August – 3 September 1999: Mr J.O. Okaronon - Training course on "Fisheries and Biodiversity Management", Nairobi, Kenya.
- April 2000: A number of project personnel (J.O. Okaronon, S.B. Wandera, L.N. Ndawula, L. Muhoozi, G. Namulemo) participated in the training of Fisheries Officers on fisheries management. The Fisheries Officers were from various districts and the training was held in Fisheries Training Institute (FTI), Entebbe.
- 16-23 April 2000: Mr L. Muhoozi – Regional Frame Survey data analysis course, Dar-es-Salaam, Tanzania.
- 15-16 June 2000: Ms Joyce Akumu: MSc thesis "Spatial and Temporal Distribution of Fish Stocks in the Napoleon Gulf of Lake Victoria", Makerere University, Kampala.

Equipment/Supplies

A number equipment and supplies were received during the reporting period. These included two fibre glass canoes delivered in August 1999.

Other activities

Other project activities included the following:

- Repairs of research vessel IBIS in Kisumu (Kenya) during July 1999.
- Review of Phase II of the project by the mid-term Review Team that arrived in Jinja (Uganda) on 20 September 1999.

Fishing Section

Gears: There were various fishing gears (Nylon and monofilament gillnets, Bottom trawlnets, Beach seines) constructed/assembled and made available for various research activities (Fish stock assessment, Fish biology and ecology etc.)

There were two bottom trawlnets, two beach seines, three fleets of nylon gillnets used in research activities. Also muiltimesh monofilament gillnets (four fleets) were introduced rigged and used only in Lake Victoria on R.V.IBIS.

Cruises: Research Vessel IBIS made a total of eight (8) cruises on research activities plus four (4) others; one to Kisumu for dry dock (July 99), then on transporting high power delegation (from Sweden, (November 1999) on a guided tour in lake Victoria Entebbe waters then a tour and fishing (trolling) on Napoleon Gulf by the Danish Foreign Affairs Minister (January 2000) and the fishing exercise by Tele Images Nature (TV production) April 2000.

R.V.Mputa has been grounded in the pier. It underwent some dry dock in Jinja pier and some major repairs were done and now awaits completion then it will be ready to cruise for research activities.

Man power: The section held manpower of sixteen (16) persons including three in marine engineering. However, the marine engineer left for Dar es Salaam early this year for further studies.

Equipment/facilities
R.V.IBIS went to Kisumu on dry dock for service and has been in a good shape but still has some problems and requires:-

- Radar service or replacement
- Life jackets
- Repairing the deck to avoid leakage's in the Nazareth and berths (cabins)
- Compass replacement
- Radio replacement (there is completely no communication system aboard R.V.IBIS – A risky situation)
- Echo sounder service/ replacement

Insurance: R.V.IBIS needs to be insured and the people on board

Developments:
- New design of trawlnet adopted and consolidated upon.
- Successful dry-docking and repairs on R.V.IBIS done in Kisumu.
- Monofilament multimesh gillnetting techniques adopted and consolidated upon.
- Painting of R.V.IBIS.
- Fixing of metal doors in place of wooden ones accomplished.

Fisheries and health issues

During the past year, the institute carried out a surveillance exercise aimed at quantifying the impact of Schistosomiasis among fishing communities in the Lake Victoria basin. The study covered Mukono, Jinja, Iganga, Bugiri and Busia districts. Landing sites were the focal point. Aquatic mollusc data, blood, stool and urine samples were taken. Although the activity is part of a larger collaboration through the Lake Victoria Basin Management Project, results are still being analysed, it was observed that bilharzia infection rates average 50% among the communities. In comparison to other communities, it was clear from the survey that protein intake (fish) of the communities at landing sites was much higher than the often quoted national average of 12kg per capita. However, other health workers – water and sanitation were quite low and probably correlated with Schistosomiasis infection rates.

Lake Victoria Environmental Management Project (LVEMP)

Introduction

The main threats facing the lake include collapse of the native fishery, decrease in fish species diversity, deterioration in the lake environment and decrease in benefits derived from the fishery as well as lack of effective information on the resources.

The Lake Victoria Environment Management Project (LVEMP) was designed to realise a healthy and varied ecosystem of Lake Victoria, which is inherently stable and capable of supporting, in a sustainable way the many human activities in the lake and its basin

The developmental objective of this project involving fisheries is concerned with poverty eradication and food security by ensuring increased and sustainable fishery production and preservation of the habitat in which fish is produced. The Fisheries Research Component is one of the ten components contributing to the goal of LVEMP and is implemented by the Fisheries Resources Research Institute (FIRRI) under the National Agricultural Research Organisation (NARO).

Objectives of the fisheries LVEMP component

- provide information on the biology and ecology of fishes to be used for sustainable exploitation of the fisheries and for improvement of stocks of endangered fish species;
- provide information on the biodiversity of the lakes flora and fauna to be used in conservation of biodiversity;
- to determine the impact of environmental degradation especially by water hyacinth on the lake system for use in ensuring the health of the environment;
- examine the socio-economic implications of use of the lakes resources;
- determine the magnitude and status of the commercially important fish species to be used in d5rawing up a management plan for the lake;
- determine and develop the potential for increasing fish production through aquaculture; and
- provide the information and database for management of the lake resources

These objectives are implemented by six sub-components namely:
1. Fish biology and biodiversity conservation
2. Aquaculture
3. Socio-economics
4. Water Hyacinth Research
5. Information and Database
6. Fish stock assessment (financed by EU)

Achievements

Over the past three years of the project life, the Fisheries Research Component has made significant progress towards achievement of the set goals through various planned activities. The following below were key achievements made by the different sub-components:

Fish Biology and Biodiversity Sub-component

- The number of fish species in Lake Victoria has declined over the past four decades
- Small satellite lakes (i.e. Kyoga minor lakes, Nabugabo lakes, Koki lakes) and some rivers (i.e. Sio River) contain some fish species (i.e. *Oreochromis esculentus, Labeo victorianus, Synodontis afrifischeri, Mormyrus kannume*) that have disappeared in the main lakes
- Some of these lakes should be designated as conservation areas for preservation of fish species threatened by introduced fish species
- Habitats with macrophyte cover and rocky outcrops serve as refugia for many endangered fish species especially haplochromines and these habitats are recommended for protection
- Most water bodies in the Lake Victoria basin are over-fertilised (eutrophic) as a result of excessive nutrient loading from the lake catchment
- Eutrophic lakes are associated with low water transparency which also corresponds to high algal biomass
- Eutrophic lakes tend to support less biodiversity than the less eutrophic ones
- Key environmental factors negatively impacting biodiversity include low dissolved oxygen, low pH, and high conductivity
- Invertebrate community composition can be used as biological indicators of environmental degradation
- Clearing of swamps and vegetation that separate minor lakes from the main lakes should be avoided to prevent spread of introduced species into them
- There is need for more detailed trophic ecology studies in order to answer the question of how energy is channeled through the different organisms in different water systems
- Drafts of two books on biology and ecology of fishes and biodiversity conservation produced
- Museum and aquaria at FIRRI partly rehabilitated and stocked
- Aquarium displays set up at UWEC, LVEMP secretariat
- Community sensitisation on conservation of biodiversity carried out at the various fish landings in the different pilot zones

Water Hyacinth Research sub-component

- Progressive information on the decline of water hyacinth and overall cover due to ecological succession and effects of biological control
- Up to date information on the distribution of water hyacinth
- Information on impacts of water hyacinth on food of shoreline fishes
- Preliminary information on impacts of sunken water hyacinth on water quality, biodiversity, fish abundance and biology.
- Information on resurgence processes of water hyacinth after decimation by effects of biological control

Information and Database sub-component

- Local area network (LAN) was partly established

- Report on Regional fisheries database was completed and the consultancy is awaited
- Library at FIRRI was rehabilitated and establishment of the database centre is underway
- A bibliographic database on Lake Victoria has been compiled and computerised through assistance of Canadian interns

Aquaculture Sub-component

- Breeding and rearing of endangered fish species including *Bagrus docmac* (Semutundu), *O. esculentus* (Ngege), *L. victorianus* (Ningu) continued
- Efforts to establish a hatchery at FIRRI-Kajjansi were made
- A training manual was produced and translated into four local languages

Socio-economics sub-component

- Compilation of available data and information on previous studies was completed and statistical outputs of the one of the data sets produced
- Studies of community involvement in harvesting and marketing of fish were carried out
- Stakeholder workshops were conducted in selected areas around Lake Victoria
- Surveys to examine socio-economic impact of water hyacinth were formulated and harmonised with Kenya and Tanzania
- Questionnaires to evaluate impact of micro-projects on local communities were produced
- Sensitisation workshops were conducted at a number of districts around the lake
- Data collection to assess fisherfolk role in environmental degradation, food variety and supply, health facilities, services, programs and housing continued.

Lake Kyoga

Native fish populations of Lake Kyoga have previously been documented as being on the decline, and, in some cases, nearing extinction. Therefore, during the period under review, experimental fishing was carried on the lake in various stations stretching between Iyingo and Bukungu.

In comparison to previous data, there was an increase in the populations of the native species during this period. The species were represented by *mormyrids* (Kasulu), *Synodontis* spp (Nkolongo), *Haplochromis* (Nkejje) and *Schilbe intermedius* (Nsere). The resurgence in their species appears to have been due to the presence of water hyacinth mats in quantities that provided refugia against Nile perch predation, and, limitations to fishing operations. However, environmental factors particularly the previous impact of El-nino rains on water level and recovery of inundated lakeshores also seem to have had a synergistic effect on species recovery in habitats which had hitherto not been suitable for fish survival.

Rastrineobola argentea (Mukene) in Lake Kyoga

Mukene, *Rastrineobola argentea* is currently among the three most important fish species in Uganda. Commercial exploitation of Mukene on Lake Kyoga started around 1995. The fishery has grown and now yields on average 220 kg of fresh fish worth U Shs. 30,000= per boat per night. Therefore, in 100 fishing nights in a year, one boat earns 3m. the total number of Mukene fishing boats has not been established. Processed Mukene from this lake is sold as far away as Sudan and the Democratic Republic of Congo.

During the year under review, biological characteristics and ecology of Mukene in Lake Kyoga were investigated. The effects of the expanding fishery on the species as well as the other species were also investigated.

Findings

The species breeds throughout the year with two peaks in the months of August and January. Least breeding occurs between April and July. The Lake Kyoga Mukene show a higher breeding frequency than is seen on Lake Victoria with at least 30% of the fish in breeding condition all the year round. Both sexes mature at 30mm SL, compared to 42mm recorded in Lake Victoria. Previously the species grew to a much smaller average adult size of 36.8mm compared to 40.8mm in Lake Victoria but of late, Mukene in the Bukungu area is comparable to the Lake Victoria population.

A 3mm-mesh net is used to catch Mukene on the lake. Although this mesh has not been harmful to Mukene itself, it captures many juvenile tilapia and Nile perch as bye-catch when operated in closed bays and near shore areas.
Investigations planned for the next period will in addition to monitoring biological parameters as the commercial fishery expands, concentrate on:

- Causes and extent of changes in population structure recently noticed in heavily exploited waters of the lake.

- Variation in species and quantities of bye-catch species with distance from the shore in order to determine the safest distance Mukene fishing should be allowed from the shoreline.

The Fishery of Lake Wamala

Introduction

Lake Wamala is a small lake and an important source of cheap protein especially for the people of Mubende District. Its area varies from 100 to 180 Km^2 depending on rain fall regimes and the lake is associated with several rivers. Rivers Nyanzi, Kabasuma and Bimbe flow into the lake whereas River Kibimba drains westwards into Lake Victoria. Lake Wamala originally had an impoverished fishery consisting of *Clarias gariepinus*, *Protopterus eathiopicus* and the Haplochromines. The fishery at the time was exploited at subsistence level by mainly using locally constructed basket traps and hooks.

To enhance the fisheries production Lake Wamala was, in 1956, stocked with three Tilapiine species namely *Oreochromis niloticus*, *Oreochromis leucostictus* and *Tilapia zillii.* The lake was opened to commercial fishing in 1960 following successful establishment of introduced species. It was then under controlled exploitation. Since then several changes have taken place in the, lake habitat, fishery, fishing effort and some biological characteristics.

The Overall Objective of this study was to investigate some biological aspects of major commercial fish species and how these aspects relate to human exploitation of the resource. This was specifically achieved by examining the species composition and relative abundance, population structure, size at first maturity of dominant species by number, average number of parasites per fish, and different sizes of gears used on the lake.

Findings

- The fish species composition and relative abundance of experimental catches, varied over time. In 1999 six fish species were recorded and the most abundant fish species by weight were, in order of importance; *O. niloticus* (37.0%), Haplochromines (24.1%), *C. gariepinus* (17.8%), *P. aethiopicus* (16.4%), *O. leucostictus* (4.2%) and in very small quantities *C. liocephalus* (0.6%). In 2000 five fish species were recorded and the most abundant fish species by weight were, in order of importance; *C. gariepinus* (54.9%), *O. niloticus* (18.1%), *P. aethiopicus* (13.0%), Haplochromines (11.7%), and *O. leucostictus* (1.7%).

- The fish species composition of commercial catches has almost remained the same whereas relative abundance has changed over time. In 1999 five fish species were recorded and the most abundant fish species by weight were, in order of importance; *O. niloticus* (90.0%), *P. aethiopicus* (5.5%), C*. gariepinus* (3.2%), *O. leucostictus (*1.2%) and in very small quantities *T. zillii* (0.1%). In 2000 four fish species were recorded and the most abundant fish species by weight

were, in order of importance; *O. niloticus* (89.3%), C*. gariepinus* (6.0%), *P. aethiopicus* (4.3%), and in very small quantities *O. leucostictus* (0.4%).

- The maximum size of *O. leucostictus* decreased from a total length of 26 cm in 1999 to 29 cm in 2000. The size range was 13-27 cm with an average lengths of 20 cm 1999 and 10-30 with an average lengths of 22 cm by 2000.

- The maximum size of *C. gariepinus* increased from a total length of 75 cm in 1999 to 103 cm in 2000. The size range was 18-77 cm with an average lengths of 35.5 cm in 1999, and 18-105 cm with an average lengths of 47.5 cm by 2000.

- The maximum size of *P. aethiopicus* increased from a total length of 95 cm in 1999 to 103 cm in 2000. The size range was 18-77 cm with an average length of 35.5 cm in 1999, and 18-105 cm with an average length of 47.5 cm by 2000.

- The size at first maturity for *O. niloticus* and *O. leucostictus* show that generally males matured at larger sizes than females. In *O. niloticus* the size at first maturity for females was 19 cm has remained around this size in 2000. The size at first maturity of males increased from 21 cm in 1999 to 28 cm in 2000. Overall the size at first maturity of *Oreochromis niloticus* decreased from 19.7 cm in 1999 to 19.5 cm by 2000.

- There was a general reduction in the average number of parasites in *O. niloticus*, from 1.3 in 1999 to 1.04 by 2000.

- Gillnets have been the major fishing gears, used on Lake Wamala. The beating method was very rampart on the lake. There has been a shift in the mesh size of gill nets used on the lake with increase in size especially *O. niloticus* from 3.5'' in 1999 and to 4'' (102 mm), 4.5'' (114 mm), and to a very small extent to 5'' (127 mm) in 2000 Hooks were also used on a very small scale and were specifically targeting *C. gariepinus* and *P. aethiopicus*.

- The depth of the lake decreased from 4.4 m in 1999 to 3.8 m by 2000.

Conclusions

- In conclusion it is important to note that the observed changes on this lake took place as a result of an environmental change, that is the El -nino rains of 1997/98 resulting into an increase in the volume and area of the lake.

Recommendations

- The Ugandan law should always be revised to suit the situation at a time for different water bodies. For instance the law prohibits catching of Nile tilapia less than 11 inches (28 cm) total length, that is the size at which 50% are mature. This corresponds to use of gill nets not less than 5 inches. This would not make it possible for the exploitation of the current Lake Wamala fisheries because the size at which 50% are mature is 19.5 cm total length which corresponds to use of gillnets not less than 4 inches.

- Control further reduction or even improve the water level by controlling the out-flow and ensuring adequate inflow through management of catchment activities.

- Construction of toilets in landings around the lake could reduce further infestation because these parasites enter the lake through human faecal material.

A draft paper on “Implications of changes in fishing regimes and the environment on the fish stocks of a small water body Lake Wamala (Uganda).” is in place.

The Fishery of Kabaka’s Lake in Kampala.

Introduction

Fish farming in ponds, dams and exploitation of small lakes in Uganda is gaining momentum to increase fish production and reduce malnutrition. They are among the major contributors to food security in the country. The Kabaka’s lake fishery is unknown and a request made by the Kabaka’s Government to FIRRI to study the status of the fishery and the means to re activate the potential of the lake was timely. A field trip was therefore undertaken during April 2000 to study the status of the fishery.

Objectives of the study

- To determine the fish species composition, relative abundance and population structure of the different fish species.

- To determine the catch rates number and Kg per net of the different fish species

- To identify the food of the fish species encountered in the lake

Findings

Four fish species belonging to three families were recorded in Kabaka’s lake. The list of the fish species encountered and the percentage contribution by number and weight are shown in Table 1.

Table 1 Fish species caught by gill nets of 25.4-203.2 mm mesh sizes in Kabaka's lake.

Family	Scientific name	Common name	Local name
CENTROPOMIDAE	*Lates niloticus*	Nile perch	Mputa
CICHLIDAE	*Tilapia zillii*	Tilapia	Kajjansi
	Oreochromis leucostictus	Tilapia	Ngege
CLARIDAE	*Clarias gariepinus*	Cat fish	Male

Length frequency distribution of different fish species encountered from Kabaka's lake showed small sized populations of *T. zillii* and *O. leucostictus.* while *L niloticus* consisted of medium sized fish and *C. gariepinus* consisted of large sized fish. Modal length class range was 9-11 cm in *T. zillli* and *O. leucostictus*, 87-89 cm for *C. gariepinus* and 48-50 cm for *L. niloticus*. Length frequency analysis of *T. zillii* and *O. leucostictus* showed two modal classes for each of the species.

The highest catch rate number per net was recorded for *T. zillii* (6 fish) followed by *L. Niloticus* (2 fish), *O. Leucostictus* (1 fish) and 0 fish for *C. gariepinus.* Catch rate weight (Kg) per net was highest for *L. niloticus* (3.2 Kg) followed by *T. zillii* (1.4), *C. gariepinus* (0.9 Kg) and the least catch rate was recorded for *O. leucostictus* (0.05 Kg). The species with the highest catch rates Kg per net were those which grow to larger adult sizes and these fish were the ones which were important in the fishery. The overall catch rate number per net was 9 fish and weight was 5.6 Kg per net. The catch rates of the different fish species caught from Kabaka's lake is shown in figure 3.

L. niloticus exclusively fed on fish. *T. zillii* fed on both insects and plants (omnivorous). Algae and detritus materials were common in the diets of both *T. zillii* and *O. leucostictus*. From the analysis of stomach contents of *T. zillii* and *O. leucostictus,* three items of prime importance were higher plant material, detritus and algae. This is probably not because of preference but may be due to the relative abundance of these food items in the habitat.

The preliminary survey showed that *L. niloticus* and *T. zillii* in that order dominate the fish catches (fresh weight) form the basis of the fishery in Kabaka's lake.

From the catch rates of the different fish species caught in the lake, there is a possibility of the lake being overcrowded which may result in stuntedness of the fish.

Higher plant material, detritus and algae were the most important food items for *T. zillii* and *O. leucostictus* while fish prey was for *L. niloticus*. However *T. zillii* also consumed insects and was therefore omnivorous.

The fishery is viable for controlled or sport fishing and therefore there is no need of restocking the lake.

Recommendation

A more detailed study to include reproductive biology in addition to what was done in this survey is required on the lake to make conclusive recommendations for sustainable utilisation of the fishery.

Kyoga minor lakes

The Kyoga satellite lakes consist of about 24 lakes of varying sizes most of which are surrounded by a swamp extending from the eastern shores of the main Lake Kyoga. The main ones are lakes Nawampasa, Nakuwa, Murlu, Namasajeri, Kiondo, Naragaga, Pachoto, Kadiko, Meito, Kodiki, Gawe, Kochobo, Kasago, Opare, Ajama, Semere, Owapet, Bisina and Opeta. Some of these lakes such as Nakuwa and Bisina also had introductions of Nile perch and changes similar to those of lakes Victoria, Kyoga and Nabugabo have occurred in these lakes.

Findings

Nine of the Kyoga minor lakes were surveyed during the period for fish species diversity. The lakes surveyed include Nawampasa, Nakuwa, Gigate, Kawi, Lemwa, Nyaguo and Agu. Over fifty fish species have so far been recorded in these lakes of which 67% belong to the haplochromine species complex. The other fish species include; *O. niloticus, Ctenopoma murei, T. zillii, O. variabilis, O. leucostictus, O. esculentus, S. afrofischeri, S. victoriae, Barbus spp, Labeo victorianus, Brycinus sadleri, Clarias gariepinus, C. carsoni, Mormyrus kannume, M. cacrocephalus, Marcucenius grahami, M. nigricans, Gnathonemus longibarbis, G. victoriae, Petrocephalus catastoma, Protopterus aethiopicus, Afromastacembelus frenatus* and *Schilbe intermedius.* Nile perch was also recorded from lakes Bisina and Nakuwa which had fish species introductions. Many of the native non-cichlids which occurred in the lakes Victoria and Kyoga before the Nile perch upsurge including the native tilapiines were recorded in these lakes. Three of the lakes, Nawampasa, Gigate and Nyaguo had the highest number of species and would be valuable in conservation of fish species diversity.

The fisheries of the Kyoga minor lakes are harvested for food but the level of exploitation is still very low since the lakes are adjacent to Lake Kyoga which is still a major supply of fish. The major threat to these lakes comes from reclamation of marginal wetlands around these lakes for agricultural purposes especially the growing of rice.

The fishery potential of the minor lake (Nabisojjo) – Luwero district.

Introduction

Luwero district before the creation of Nakasongola district had a share of south-western portion of lake Kyoga. After loosing the portion of the lake, they want to resort to the minor lake (Nabisojjo) for supply of fish at least to the population around this lake. The plans are to start commercial fishing. The lake is 45 km from Luwero town adjacent to the road going to Ngoma town. River Nabisojjo, a tributary of R. Mayanja flows through the lake on its way to R. Kafu.

In August 2000 there was one fishing canoe using one old gillnet of 3" mesh size. The fishing was for subsistence. It was reported that the presence of the lake was noted as early as 1950s but there has been no study conducted to establish the status of the fishery. The local authorities reported that 18,000 Tilapia fry from Lake Kyoga were stocked in the lake in May 1999 and expected the first harvest in June 2000.

The main objective of the scientific field study on L. Nabisojjo was therefore to generate information on the status of the lake fishery and recommend to the local authorities the next line of action.

Two fleets of gillnets of 1 – 8" were used to sample the fish population of the lake. 1" – 5.5' mesh size nets were at 0.5' intervals and 6'-8" at 1" interval. One fleet was set along the shoreline and a second fleet set offshore during the night. Day catches were very poor and will not be discussed in the results. The fish catches were sorted according to the mesh size and location of setting. Fish were identified, sexed assigned gonadal state and biometric measurements were taken. Where possible stomach contents were identified in the field and for the tilapiines the contents were preserved in 5% formalin for subsequent analysis in the laboratory.

Findings

Fish species identified in the gillnet fishery.

8 species were identified namely: *Astatotilapia nubila, Gnathonemus vitoriae, Oreochromis niloticus, Oreochromis leucostictus, Oreochromis esculentus, Protopterus aethiopicus, Clarias gariepinus* and *Barbus kasterni*.

*Fish species composition, abundance and distribution in the gillnet fishery***.**

The most dominant fish species was the indigenous *O. esculentus* contributing 60.6% of the total weight of the catch in the offshore waters (Table1a) and 19.8% along the shore line (Table 1b) based on total fresh weight of all the species caught. The species was caught more efficiently in the 3" mesh size gillnets both offshore (92.4%) and along the shoreline (45.8%). The second in importance was *C.gariepinus* (29.6%) over all contribution off shore and 31.9% along the shoreline. *G. victoriae* was abundant (30% over all) along the shore line in 2" mesh size nets (Table 1b) and catches offshore were very low (2%) over all contribution in experimental catches.

Table 1 a and Table 1b summarises the distribution of different fish species in the various gillnet mesh size nets along the shoreline and offshore in the gillnet fishery. The highest mean catch per net per night 10.550kg was recorded in the 3" mesh size nets offshore as a result of high catches of *O. esculentus* (92.4%) of the catch. Along the shoreline, the highest catch rates 3.6kg per net per night and 3.5 kg per net per night were contributed by mainly *G. victoriae* in the 2.5"mesh size (88.1% by weight) and *O. esculentus* in the 3" mesh size nets (45.8%) of the catch respectively.

The major gillnet fishery was therefore *O. esculentus* offshore. All the species caught seem to be indigenous with the exception of *O. niloticus* and *O. leucostictus* which probably could have been the ones introduced from L. Kyoga. Only one *O. niloticus* was caught and had a total length of 36 cm and weighed 975 g. Eight *O. leucostictus* had an average weight of 200.6g and a size range of 16.7 - 28.6 cm TL.

Size structure of the major fish species

The size structure of *O. esculentus* in the gill net fishery is shown in Figure 1. The fish had a size range of 6 – 27 cm TL with the mode at 20 – 21cmTL.

Clarias gariepinus size range was 30 – 99 m TL with a mode at 40 - 44 cm TL(Fig.2). Though *G. victoriae* appeared abundant in the 2" mesh size nets along the shoreline, it is a small fish and exploitation will interfere with the juveniles of important fish species. The species from the 1.5 – 2" gill net mesh size nets were all mature.

Size at first maturity for O.esculentus

The size at first maturity for *O. esculentus* was determined as 19 cm TL for combined sexes and all fish were mature at 22cm TL and sex ratio was 2:1(males: females).

Gillnet selectivity of O. esculentus

The selectivity of gillnets on *O.esculentus* is shown in Figure 3. The 3" mesh size nets harvested mature fish. This mesh size can therefore be used to harvest the fish offshore with little interference of other species. The species is stunted due to over crowding. Reduction in population density in the lake would allow the species to grow to a larger size.

Feeding

C. gariepinus fed on termites and fish especially *O.esculentus* and haplochromines which were identified in the stomach contents.

Predators: The fisherfolk communities reported the presence of otters though the scientists never saw them. There are also hippos though their population is not well known.

The lake fishery is viable when exploitation for *O. esculentus* is carried out using 3" mesh size nets fished passively offshore and by allowing at least four fishermen

each to operate 4 nets on the lake. This could be tried for 6 months and a survey then carried out to establish whether the size of the fish has increased. Increasing the volume of the lake by cutting the huge swamps that surround it would also increase the volume of the water, reduce on over crowding and improve *O.esculentus* size for harvesting. It is possible that there could be a recreative hook fishery for *P.aethiopicus* and *Clarias gariepinus.*

Experimental fishing will be conducted during the next fishing trails. The stocked fish from L. Kyoga which, probably composed of *O. niloticus* and *O. leucostictus* did not do well probably because the lake was already over crowded with stunted *O. esculentus*.

It has been noted (Welcome, 1998) that when fish are stocked into populations when natural reproduction occurs, the dynamics of the process becomes uncertain. Impacts can be anticipated particularly on density dependant factors such as feeding and population density where mortality would increase and growth rates decreased due to addition of excess elements to the stock. Natural reproduction may also be inhibited where the fish used for stocking are drawn from a strain not adopted to the recipient water body. Such problems could have led to unsuccessful venture of stocking the lake before studies were carried out to ascertain the status of the fishery.

Conclusion

- Lake Nabisojjo has stunted *O.esculentus* as the dominant fish species which can be exploited using 3" mesh size gillnets offshore.
- The hook fishery for *C.gariepinus* and *P. aethiopicus* could be exploited after experimental trails have ascerted the importance of the fishery.
- The stuntedness of *O. esculentus* could be eliminated by increasing the volume of the lake and fishing out *O. esculentus* which is over crowded.
- The stocking exercise was not very successful according to the preliminary results
- Competition for space and food could have led to low reproduction rate of the introduced species from L. Kyoga.
- The *O. niloticus* and *O. leucostictus* may not be indigenous species of the lake. They could be the species that were introduced in the lake from L. Kyoga over a year ago and have failed to successfully establish themselves.

Tentative recommendations

- Exploit *O. esculentus* offshore using 3' mesh size nets to reduce the over crowding.
- Allow at least 4 canoes with 4 nets each to tentatively operate on the lake for at least the next 6 months.
- Carryout research on possible exploitation of *P. aethiopicus* and *C. gariepinus* using hooks and follow up their exploitation.
- Increase the volume of the lake to reduce on over crowding of *O.esculentus.*

Table 1(a). Fish species composition, abundance and distribution by weight (g) in offshore experimental gillnet mesh size nets of 1" – 8" on Lake Nabisojjo (August 2000). The figures in brackets indicate percentage contribution by weight of individual fish species to the total weight of fish caught in each gillnet mesh size of net.

	Mesh size (inches)														
Taxa	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	7	8	Total (g)	Overall % in catch
A. nubila	52 (8.0)	20 (1.8)												72	01
G. victoriae			900 (17.9)	220 (3.2)										1120	2.0
O. leucostictus					700 (3.3)		750 (77.3)							1450	2.5
O. esculentus	574 (88.2)	930 (82.3)	5025 (84.4)	5950 (86.7)	19500 (92.4)	2680 (42.5)	220 (22.7)							34879	60.6
O. niloticus														0	0.0
P. aethiopicus				450 (6.6)		2500 (39.7)								2950	5.1
C. gariepinus		180 (15.9)		245 (3.6)	900 (4.3)	1125 (17.8)			400 (100)			6000 (100.0)	6500 (100.0)	17050	29.6
B. casterni	25 (3.8)													25	0.04
Total(g)	651	1130	5925	6865	21100	6305	970		2100			6000	6500	57546	
Mean catch(g) per net per night	325.5	565.0	2962.5	3432.5	10550.0	3152.5	485.5		1050.0			3000.0	3250.0		

Table 1(b). Fish species composition, abundance and distribution by weight (g) at the shoreline in experimental gillnet mesh size nets of 1"-8 on Lake Nabisojjo (August 2000). The figures in brackets indicate percentage contribution by weight of individual fish species to the total weight of fish caught in each gillnet mesh size of net.

	Mesh sizes(inches)														
Taxa	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	7	8	Total (g)	Overall % in catch
A. nubila	240 (90.9)	606 (79.1)	25 (0.3)											871	2.9
G. victoriae		65 (8.5)	6360 (88.1)	230 (10.2)										6655	30.0
O. leucostictus				75 (3.3)	200 (2.8)									275	0.9
O. esculentus	24 (9.1)	88 (11.5)	165 (2.3)	555 (24.7)	3240 (45.8)	1930 (35.0)								6002	19.8
O. niloticus											975 (100.0)				
P. aethiopicus			370 (5.1)	579 (25.5)	2655 (37.5)	2250 (40.8)								5854	19.3
C. gariepinus			300 (4.2)	810 (36.0)	985 (13.9)	1330 (24.1)	1100 (100.0)	1140 (100.0)		4000 (100.0)				9665	31.9
B. casterni		7 (0.9)													
Total (g)	264	766	7220	2249	7080	5510	1100	1140		4000	975			30304	
Mean catch (g) per net per night	132.0	383.0	3610.0	1124.5	3540.0	2755.0	550.0	570.0		2000.0	487.5				

Aquaculture Programme

Background

Given the fact that most of the capture fisheries are on the decline, aquaculture development holds the key to increased fish production in Uganda.

Research objectives

To enhance fish production through fish farming and advise on the economic feasibility of various aquaculture systems.

Constraints addressed

Key constraints addressed included:
- Siting and construction of ponds
- Inadequate availability of quality fry
- Extension advice

Socio-economics sub-programme

Background

During 1999, socio-economics studies have been carried out aimed at:

- Strengthening the implementation of fisheries management on the water bodies for sustainability
- Enhancing the gains from fisheries resources to the local communities and the nation at large, and
- Improving environmental practices among fishing communities.

Research focus

The research was carried under two projects, namely the EU funded Lake Victoria Fisheries Research Project (LVFRP) and the World Bank funded Lake Victoria Environmental Management Project (LVEMP)

Lake Victoria Fisheries Research Project

Under the EU funded LVFRP, fisheries management studies have examined fishermen's knowledge and attitude towards fisheries regulations and the Fisheries Department.

The findings reveal considerable knowledge among fishers of fishery regulations and the consequences of fishing malpractices. Their attitude towards the Fisheries Department is however, often negative.

Some of the causes for the rampant use of illegal gear have been identified to include:

- The rather strong preference among consumers for immature fish on the domestic market and to some extent among fish processors
- Poverty among fishermen, which makes it difficult to afford the recommended gear.
- Rampant theft of fishing gear, prompting fishers to use active fishing methods.
- Non-ownership of the resources by the users.
- Limited capacity of the Fisheries Department and the Districts to enforce regulations, due to limited personnel, lack of facilities and operations budgets.

Greater involvement by local communities to fisheries management in formulation and implementation is considered key to fisheries management success. However, co-management proposals are likely to be undermined by the following factors:

- The open access nature of the fisheries resources is a limiting factor to any serious commitment by communities to obey the regulations
- Lack of strong community based organizations
- Lack of boundaries and the high migration by fishers

The project is now in the process of monitoring management at a pilot beach, for experiences to be replicated to other areas of the lake.

Lake Victoria Environmental Management Project

The aim of the Socio-economic studies under LVEMP seek to generate data that would be used to formulate policies governing management and utilization of Lake Victoria resources with greater community participation in formulation and implementation, so as to enable them maximize benefits from the fishery.

Achievements

1. A training workshop has been held on the study of "Community involvement in fisheries, from production to distribution." The training imparted knowledge to the research personnel on theoretical concepts, data collection instruments and sampling procedures in the field.
2. District workshop for stakeholders was conducted, at which preliminary findings from the study of community involvement in the fisheries from production to marketing were presented to the fisherfolk. Feed back on the findings and recommendations for further implementation of the research were obtained.
3. Beach level meetings were conducted at which implementation of the research was discussed with various grassroots fishermen, for their feedback and participation into the research process. Research information was passed over to the communities during the meetings.
4. National stakeholders' workshop was held. The workshop disseminated information and generated recommendations on the issues of fishermen's earnings, food supply and environmental health, including:
   a) Enhancing productivity of fishermen.
   b) Strengthening the market for fish for greater earnings.

c) Opportunities open to fishermen for investing their surplus earnings.

d) Strategies for increasing fishermen's food production.

e) Strategies for strengthening food trade to supply fishing communities.

f) Recommendations on fish exports in relation to food security for the fisherfolk.

g) Improving fishermen's health through better sanitation and hygiene.

Other resolutions and arrangements for district level workshops were made.

5. Regional harmonisation workshop was held from 27 September to 1 October, 1999 at the LVEMP National Secretariat, Entebbe and a report produced. The workshop developed consensus on the issues of:

   h) The wider socio-economics program on Lake Victoria.

   i) Harmonization of format for reporting of findings from the on-going studies and of the research tools for the studies planned for the current year.

   j) The core elements of the socio-economics databases.

   k) Other socio-economics studies under LVEMP components that need to be addressed.

   l) Training for the socio-economics Sub-program.

   m) Linkages with relevant activities and institutions.

   n) Association of fisheries socio-economists.

   o) Resolutions and arrangements for subsequent meetings and workshops.

6. Field data collection continued on the on-going study under the project. Information has been generated on:

   a) Status of the fishing settlements, covering facilities and amenities available, main sources of income to fish workers, types of food available to them and their sources.

   b) Main diseases afflicting the fishing communities and the health facilities and programs available at the beaches

   c) Socio-economic characteristics of the different categories of fish workers, including age, sex and family size and their implications for their productivity.

   d) Limiting factors to fish production, namely fish scarcity, gear and boat limitations and regulations, among others.

   e) Inadequate access to productive assets, namely boats and gear, processing and trading equipment and its effect on earnings of fish workers.

   f) Poor market for fish in the districts, due to low purchasing power, leading to low prices. Inadequate action from the districts to address sanitation issues was considered to limit fish exports.

   g) Non-payment for fish deliveries by factories, agents and even regular traders.

   h) Low levels of fish business skills among fish workers, including inadequate book keeping and managerial skills.

i) Inadequate credit facilities and poor risk management in the districts.

j) The fishery activities are threatened by a series of risks and uncertainties, including theft of gear, unpredictable market, monthly cycles of moon light that affect catch and hazards associated with the lake like lightning and danger of drowning.

k) Social factors, particularly the role of culture and indigenous knowledge in fish production and fish quality

l) Inadequate institutional support to fish workers in the districts in the areas of extension, research, fisheries management, policies and development projects.

m) Knowledge, attitude and practices of fish workers towards the fishery resources and the environment, including trees/forests, shrubs and grass, wetlands, domestic, human and fishery wastes, in particular disposal of plastic and polythene wastes.

Other problems of the fisherfolk identified include:

- Unbalanced diet that depends too heavily on fish and cassava.
- Lack of interest in and facilities for education.
- Poor health status characterised by high incidence of malaria, diarrhea, bilharzia, skin infection and aids, and isolation.
- Because they are marginalized communities and their status is regarded as extremely low, they are not covered under most of the development programs that address poverty and other social concerns in the country.

7. Dissemination of findings, carried out using the following outputs:

a) Field trip reports, presenting observations made during field activities.

b) Report of National Stakeholders' Workshop.

c) Report of Regional Harmonisation Workshop.

d) District level workshop reports, summarizing preliminary findings of research and responses from the stakeholders.

e) Reports of the beach level meetings.

f) Quarterly progress reports, covering the planned activities, achievements and issues arising from the research.

8. Linkage activities were carried out, through which the socio-economist was able to relate with the relevant institutions and activities for complementarily.

9. Short and long term training, under which the socio-economics PhD candidate continued with his field data collection.

10. Procurement of equipment. The Sub-component has been considerably strengthened in its implementation as a result of procurement of the items below: vehicle (1), motorcycles (2), outboard engine (1), boat (1) and dingy (1).

Marine Services

Fishing section

The focus was on fishing gears, Cruises, Manpower, Equipment/facilities and Developments.

Achievements

Gears: There were various fishing gears (Nylon and monofilament gillnets, Bottom trawlnets, Beach seines) constructed/assembled and made available for various research activities (Fish stock assessment, Fish biology and ecology etc.)

There were two bottom trawlnets, two beach seines, three fleets of nylon gillnets used in research activities. Also muiltimesh monofilament gillnets (four fleets) were introduced rigged, and used only in Lake Victoria on R.V.IBIS.

Cruises: The Research Vessel, IBIS made a total of eight (8) cruises on research activities plus four (4) others; one to Kisumu for dry dock (July 99), then on transporting high powered delegation (from Sweden, (November 1999) on a guided tour in lake Victoria Entebbe waters a tour and fishing (trolling) activity on Napoleon Gulf by the Danish Foreign Affairs Minister (January 2000) and the fishing exercise by Tele Images Nature (TV production) of France during April 2000.

R.V.Mputa has been grounded at the pier. It underwent some dry dock in Jinja pier and some major repairs were done and now awaits completion then it will be ready to cruise for research activities.

Man power: The section held manpower of sixteen (16) persons including three in marine engineering. However, the marine engineer left for Dar es Salaam early this year for further studies.

Equipment/facilities: R.V.IBIS went to Kisumu on dry dock for service and has been in a good shape but still has some problems and requires:-

- Radar service or replacement
- Life jackets
- Repairing the deck to avoid leakage's in the Nazareth and berths (cabins)
- Compass replacement
- Radio replacement (there is completely no communication system aboard R.V.IBIS – A risky situation)
- Echo sounder service / replacement
- New design of trawlnet adopted.
- Successful dry-docking and repairs on R.V.IBIS done in Kisumu.
- Monofilament multimesh gillnetting techniques adopted and consolidated.
- Painting of R.V.IBIS.
- Fixing of metal doors in place of wooden ones accomplished.

Insurance: R.V.IBIS needs to be insured as well as the people who are regularly on board

Information Services

During the period under review, significant progress has been made in the area of information delivery services. Library collections were transferred to more spaceous premises and library staff undertook specialised training. An accession list of all reprints on African lakes and all new monographs were entered into a computerized database. With a Local Area Network beginning to take shape, institute staff became aware of ICT and the use of the Internet. As well, numerous publications (reprints, books, reports, etc) were procured from European and American based scientists.

Laboratory services

The institute's laboratory services were called upon to participate in a Lake Victoria wide collection of water and sediment samples related to the fish export ban. Collected samples were successfully handled and shipped to accredited laboratories in the Netherlands.

Laboratory staff were also targeted for specialized training in various techniques including fish taxonomy and genetics, secondary production and zooplankton taxonomy. Over the reporting period, the laboratory section also handled a six-months industrial training activity for Kyambogo Polytechnic students.

Stores

The stores is a very important part of the institute and deserves a lot of attention. First and foremost it needs to be re-arranged and bin cards introduced. With the obsolete items in the stores and few rooms available it was not easy to arrange and introduce the bin cards.

Objectives

- Improvement in record keeping
- Disposing off obsolete items and expired chemicals
- Transparency in purchasing

Achievements

- All institute assets are now recorded in asset registers indicating their location and users
- Bid analysis forms, local purchase orders, local purchase indents have been introduced
- Stores have been renovated and the renovation is still going on
- FIRRI - Kajjansi has employed a hired Stores assistant

Recommendations

- There is a need for a purchasing Officer
- Need for disposing off obsolete items and expired chemicals to create room for new ones
- Need to recruit a Stores assistant at Kajjansi station

Abstracts

Pollution from point sources into the urban wetlands of Jinja Municipality, Uganda (*Oguttu Hannington M.Sc thesis*)

Abstract

Lake Victoria shoreline in Jinja Municipality has four urban wetlands of Kirinya West/Loco, Kirinya East/Walukuba, Masese and Budumbuli which have undergone major changes during the past fifty years due to increased human activities. Amongst these activities is the continuos inflow of agricultural run-off, industrial and municipal wastewater. A significant increase in nutrient loads of Nitrogen and Phosphorus from the catchment area continues to enhance eutrophication of Lake Victoria. Pollution from point sources (Industrial plants and NWSC Kirinya final maturation pond) into Jinja's urban wetlands were therefore studied using a simplified material flux analysis methodology to identify the active elements and estimate the pollution loads due to Nitrogen, Phosphorus, Carbon (nutrients), Chromium, Copper, Lead, Nickel and Manganese metals.

Kengrow Industries (food processing), Gomba and Agro-Marine (fish filleting) Industries gave high potential loads of Nitrogen, Phosphorus and Carbon between point source groupings. Gomba Fishing Industries Ltd. with an inefficient treatment pond (COD:BOD=1.4:1 cf 2:1) showed the highest potential loads of 0.31 tones/yr. NO_3-N, 0.03-1.06 tones/yr. NH_4-N and 0.44-1.35 tones/yr. PO_4-P. Kengrow Industries Ltd, discharging oily and soapy effluent without on site pretreatment showed the highest organic matter load of 11.60-77.51 tones/yr COD. Agro-Marine Export Processing Co. Ltd. without treatment pond (COD:BOD=3.6:1 cf 2:1) had 0.08-0.15 tones/yr. NH_4-N, 0.31-0.63 tones/yr. N-T and 0.21-0.62 tones/yr. PO_4-P. These values reflected Agro-Marine's low daily fish products.

Leather Industries of Uganda (tannery) showed a load range of 0.09-4.12 tones/yr. Chromium, a toxic element which exceeded maximum permissible limits of 0.05 mg/l Cr VI by approximately 5280 times. The highest mean conductivity value of 5500.8$\pm$144.5 μS/cm (tannery) was due to large amounts of Sodium Chloride, Sulphides, Acids and Chrome salts used during Chrome tanning of animal hides and skins. Metallurgy point sources of Chillington Co. Ltd. and Steel Rolling Mills Ltd. showed 0.12-0.16 mg/l Cr VI and 0.23-0.30 mg/l Cr VI arising from scrap metal and steel plates respectively. The rest of total metal concentrations (Cu, Pb, Mn) were below maximum permissible limits though bio-accumulation is possible.

NWSC Kirinya final effluent showed the highest potential load range between point source groupings of 1.89-5.18 tones/yr. PO_4-P, 11.40-21.00 tones/yr. NH_4-N (44.84-124.95 tonnes / yr. N-T) and an Organic carbon load of 80 tones/yr. (COD+BOD_5) into Kirinya West/Loco urban wetland. In addition, the study suggests an industrial load estimated at 155 tones/yr. Organic carbon, 1.3 tones/yr. Nitrogen, 2 tones/yr. Phosphorus and 4 tones/yr Chromium VI from Leather, Gomba, Agro-Marine, Kengrow and Uganda Bread Industries through public sewers into NWSC Kirinya ponds. Kirinya East Wetland/Walukuba urban wetland received a low mostly domestic and surface run-off effluent from Walukuba East & West, Masese III and Babu Patel housing estates while peri-urban wetlands of Masese and Budumbuli received the least industrial loads as only Steel Rolling Mills Ltd. metallurgy point source was functional. Kirinya West/Loco urban wetland is therefore the most nutrient rich urban wetland in Jinja Municipality and may not consistently retain sustainable nutrient loads and total metals as wastewater concentrations of most of these salts exceed wetland growth requirements. Industrial wastewater should therefore be treated on-site to non critical levels prior to final discharge through NWSC Kirinya ponds into Kirinya West/Loco urban wetland

for tertiary treatment. This will improve nutrient stripping by Jinja's urban natural wetlands and hence protect Lake Victoria ecosystem from further toxic effects.

The biology and ecology of Oreochromis niloticus in the Ugandan part of Lake Victoria and the importance of bays and gulfs in conservation of fish species diversity (*MSc. Thesis – J. Akumu***)**

ABSTRACT

Lake Victoria, once a multi-species fishery, now depends on three major commercial species (*Lates niloticus, Oreochromis niloticus* and *Rastrineobola argentea*). Introductions of Nile perch, overfishing, and competition among different species appear to have contributed to the decline in fish diversity in the system. However, insufficient knowledge on distribution and abundance has limited our assessment of the decline. This study conducted from January to June 1996 used experimental gillneting to assess the temporal and spatial distribution of fish in open lake and lake-river interface areas of Napoleon Gulf of Lake Victoria during the two phases of the moon, i.e. full moon and no moon (total darkness).

The Gulf consists of permanent streams (Bugungu, Budumbuli, and some other small streams) and is indented with numerous sub bays. In the lake-river interface, some endemic endangered fish species that had been assumed decimated from the overall lake ecosystem were found, suggesting that this area functions as a refugium for these fish species. In general, both fish abundance and diversity were higher in shallow areas due to the structural complexity of the ecotonal zones. *Oreochromis niloticus* was found to be more abundant in shallow inshore areas with high macrophyte cover, than larger fish (e.g. *Lates niloticus*) which dominated deeper areas (open lake offshore). Abundance of fish species was higher during total darkness than under moonlit conditions, and also higher in the rainy season than during the dry season. There was no significant difference in condition factor and size frequency distribution between populations of *L. niloticus* and *O. niloticus* in the lake-river interface and open lake. Study findings revealed that Nile perch and *Oreochromis niloticus* populations are well established in their respective habitats. The association of species to specific habitat type may suggest that distribution of individual species was governed by the relative abundance of preferred food and other resources like refugia and breeding grounds. The study therefore, recommends that appropriate fishing methods and gears should be adhered to, especially in the inshore areas of the two stations where high fish diversity was encountered . The appropriate use of these reservoir areas will contribute to the maintenance of fish diversity in Lake Victoria for biological and socio-economic sustainability.

List of Publications

L.S. M. Schouten, H.J.C. van Leeuwen, J.G.M Bakker, **T. Twongo**, 1999. Water hyacinth detection in Lake Victoria by means of satellite SAR. BCRS project 3.4/AP-04. SYNOPTICS Integrated Remote Sensing & GIS Applications, Wageningen, the Netherlands.

Odongkara, O.K. and **J. O. Okaronon**, 1999. Impact of economic reforms on the performance of fish processing firms and the fisheries resource. In Godfrey Bahiigwa: Capacity building for integrating environmental considerations in development planning and decision-making with particular reference to the fishing industry in Uganda. Economic Policy Research Centre, Makerere University, Kampala. 8-26.

Ogutu-Ohwayo, R., 1999. Deterioration of length-weight relationships of Nile perch, *Lates niloticus* L. in lakes Victoria, Kyoga and Nabugabo. *Hydrobiologia.*

Gregory C. Booton, Les Kaufman, Mark Chandler, **Richard Ogutu-Ohwayo**, Wenrui Duan, and Paul A. Fuerst, 1999. Evolution of the Ribosomal RNA internal transcribed spacer one (ITS-1) in cichlid fishes of the Lake Victoria Region.

Twongo T., 1999. Invasive water weeds in Africa and options for their control. At African water resources management policy conference. Sharing knowledge to manage Africa's fragile water resources in the 21st century. May 26th – 28th, 1999. Nairobi, Kenya.

ANNEX 1. STAFF LIST

Sn.	Name	Designation	Qualifications
1.	Dr.R.Ogutu-Ohwayo	Director	B.Sc.,M.Sc.Phd.
2.	Dr.T.K.Twongo	Principal Research Officer	B.Sc.,M.Sc.Phd
3.	Dr.J.S.Baliriwa	Senior Research Officer	B.Sc.,M.Sc.Phd
4.	Mr.K.O.Odongkara	Senior Research Officer	B.Sc.,M.Sc.
5.	Mr.J.Kamanyi	Senior Research Officer	B.Sc.,M.Sc.
6.	Dr.L.M.Ndawula	Research Officer	B.Sc.,M.Sc.Phd
7.	Mr.J.O.Okaronon	Research Officer	B.Sc.,M.Sc.
8.	Ms.R.Mugidde	Research Officer	B.Sc.,M.Sc.
9.	Mr.S.B.Wandera	Research Officer	B.Sc.,M.Sc.
10.	Mr.S.Sekiranda	Research Officer	B.Sc.,M.Sc.
11.	Mr.F.M.Wanda	Research Officer	B.Sc.,M.Sc.
12.	Mr.L.Muhoozi	Research Officer	B.Sc.,M.Sc.
13.	Mr.J.P.Olowo	Research Officer	B.Sc.,M.Sc.
14.	Ms.G.Namulemo	Research Officer	B.Sc.,M.Sc.
15.	Ms.J.Akumu	Research Officer	B.Sc.,M.Sc.
16.	Mr..D.Mbabazi	Research Officer	B.Sc. (Educ.), M.Sc.
17.	Mr.James Wasukira	Marine Engineer	MSc. Eng
18.	Mr.L.Kibirige	Master Fisherman	Dip. Master Fisherman, Dip. Gear Technology,
19.	Mr.M.K.Magumba	Chief Laboratory Technician	SLT/ALT EAACE
20.	Mrs.Elise.Apama Twongo	Senior Laboratory Technician	Cert (Env. Technology) SLT I,SLTII, EAACE, Graduate Dip. City Guilds.
21.	Mr. Robert Amina	Senior Laboratory Technician	SLT I, SLT II, UACE
22.	Mr. Fred.Mugume	Senior Laboratory Technician	SLT I, SLT II, UACE
23.	Mr. Vincent.Kiggundu	Laboratory Technician	Dip (SLT) Biology, UACE
24.	Mr. Henry.Ocaya	Laboratory Technician	Cert. (S&T.1) UACE
25.	Mr. Hannington.Ochieng	Laboratory Technician	Dip. (SLTI) Biology, UACE
26.	Mr. Sam. Bassa	Laboratory Technician	Cert.(SLT I) UACE
27.	Mr. Opolot Oula	Laboratory Technician	Dip. Fish Mg. Methods and Gear Technology
28.	Ms.Nsenga Monica	Laboratory Technician	Dip. (SLT) Biology, UACE
29.	Mr.Rwabwera Kakuru	Records Assistant	Advanced Dip. In Mgt. Cert. Records & information
30.	Ms. Florence Bazanya	Secretary	Cert. G.P. (Steno), Cert. (Soc. Studies), UACE
31.	Ms.Joyce Nakimbugwe	Typist Cum Clerk	Cert. (Typing 50 WPM)
32.	Ms.Rose Ikanza	Typist Cum Clerk	Cert. (Typing 50 WPM)
33.	Namara Jessica Twinomujuni (Mrs)	Typist Cum Clerk	Cert. Secretarial, Cert Computer Oper.

34.	Ms.Ngangeo Solo	Telephone operator	Cert. Tel. Operations
35.	Mr.Ignatius Nsanze	Ag.Finance/Admin. Officer	O' level, HDM.B.com
36.	Mr.Stephen Okwakol	Accounts Assistant	O'Level
37.	Mr.Geoffrey Muhindo	Accounts Assistant	UDBS
38.	Ms.Scarlet Agabirwe	Cashier	UDBS
39.	Mr.Okoth Ochwo	Audit Assistant	HDM
40.	Ms.Lydia Nambalirwa	Stores Assistant	DSM
41.	Ms.Connie Tumwine	Librarian	B.Sc.,P.G.D. Lib. Science
42.	Ms.Florence Kakolwa	Assistant Librarian	DLIS
43.	Mr.S.N.Sowobi	Draughtsman	Cert. (Cartographic Tech),
44.	Mr.Erifazi Ndwokya	Artisan (Mechanic)	City & Guilds in Agric
45.	Mr.Joshua Mugogo	Artisan (Joiner)	Certificate
46.	Mr.John Peter Amitu	Carpenter	Ug. Junior Technical Cert.
47.	Mr.John Were	Coxswain	'O' level
48.	Mr.Isa Musana	Coxswain	Intern. Cert., MV Techn., Cert. MV Techn., Part I 'O'
49.	Mr.Wanok Wanume	Deckhand Grade I	P. 7
50.	Mr.Simon Kikonyogo	Deckhand Grade I	Certificate
51.	Mr.Richard Esimu	Deckhand Grade I	S.3
52.	Mr.Charles Baliise	Deckhand Grade I	Certificate
53.	Mr.Jackson Bwire	Deckhand Grade I	J.2
54.	Mr.Abedi Bagaga	Deckhand Grade I	P.7
55.	Mr.Stephen Wesige	Deckhand Grade I	P.7
56.	Mr.Ssonko Badru	Deckhand Grade I	S.2
57.	Mr.Salim Mukose	Deckhand Grade I	S.2
58.	Mr.David Balidawa	Driver	P.7
59.	Mr.Ali Katende	Driver	P.7
60.	Mr.Moses Bifamengo	Driver	P.7
61.	Mr.Aloysius Wandiba	Security Guard	P.7
62.	Mr.Joseph Ojeke	Security Guard	S.1
63.	Mr.Thomas Baliraine	Security Guard	P.5
64.	Mr.Abdu Mwima	Security Guard	P.4
65.	Mr.James Kintu	Office messenger/cleaner	P.7
66.	Mr.Asonya Boniface	Office messenger/cleaner	P.7
67.	Ms.Rose Kabalinzi	Office messenger/cleaner	P.4
68.	Mr.Denis Kiwanuka	Office messenger/cleaner	O'Level

FIRI STAFF AT KAJJANSI STATION

69.	Mr.Owori Wadunde	Officer – In-Charge	B.Sc, M.Sc
70.	Dr.Mbahinzireki.G	Research Officer I	B.Sc, M.Sc.PhD

71.	Dr.Isiagi Nelly.A	Research Officer 1	B.Vet.,Med., M.Sc
72.	Mr.Olet.Ogwang	Research Assistant	B.Sc.
73.	Mr.Masaba.A.F	Lab.Technician	Diploma
74.	Mr.Kityo.G	Lab.Technician	Diploma
75.	Mr.Ocen-Egau.Dl.	Lab. Technician	Diploma
76.	Mr.Busulwa.G	Accounts Assistant	B.Com
77.	Ms.Nababi.H.E	Typist-Cum-Clerk	Cert. Typing
78.	Ms.Bidawo.K	Typist-Cum-Clerk	Cert. Typing
79.	Mr.Bugagga.J	Driver	J.2
80.	Mr.Semogerere.P	Security Guard	P.7
81.	Mr.Rwambuga.E	Security Guard	P.7

Resignations

1.	Dr.F.W.B.Bugenyi	SPRO	BSc, MSc, PhD
2.	Mr.Nyonyintono Peter	Lab.Technician	Diploma
3.	Mr.Ddungu Brain	Lab. Technician	Diploma
4.	Mr.Magenzi	Driver	S.2

Retirements

5.	Mr.Mwanja Juma	Driver	
6.	Mr.Mboizi Damiano	Security	

Transfers

7.	Mr.Kasirye Joseph	Accounts Assistant	Cert.

Deceased

8.	Late.Mr.Okiror Etabon Emmanuel	Administrative Officer	B.A
9.	Late.Mr.Ziraba Haruna	Deckhand	P.7

NON- NARO STAFF AT FIRRI-UGANDA

Sn.	Name	Designation	
1.	Oguttu Hanington	Research Assistant	B.Sc, MSc.
2.	Jane Nagayi	Research Assistant	B.Sc, MSc.
3.	Maxwell Kabi	Research Assistant	B.Sc
4.	Mercy Kyangwa	Research Assistant	B.A
5.	Anna Nyapendi	Research Assistant	Dip.
6.	Joseph Gonga	Research Assistant	Cert.
7.	Agness Nasuna	Research Assistant	Dip.
8.	Alice Atai	Research Assistant	Dip.
9.	Anthony Taabu	Research Assistant	BSc.
10.	Kubaiza Rahma	Research Associate	B.U.S
11.	Ocenodongo D	Research Associate	BSc, MSc
12.	Janet Naluwairo	Lab Technician	Dip.
13.	Godfrey Magezi	Lab Technician	Dip
14.	Jane Luyiga	Lab Technician	Dip
15.	Patrick Bwire	Lab Assistant	Dip
16.	Willy Pabire Gandhi	Lab Technician	Dip
17.	Egransi Ganda	Lab Technician	Dip
18.	William Okello	Lab Technician	Dip
19.	Muhumuza Elias	Lab Technician	Dip
20.	Damalie Namuyonga	Lab. Assistant	Cert.
21.	Nalubega Gladys	Aquarium Attendant	Cert.
22.	Olivia Tibeijjuka	Typist cum Clerk	
23.	Nandudu Linda	Housekeeper (Guesthouse)	
24.	Emile	Housekeeper (Guesthouse)	
25.	Gonza H	Library Attendant	S.6
26.	Ongaria Patrick	Library Assistant	Cert.
27.	Charles Isabirye	Artisan	Cert.
28.	Yokowasi Muyita	Mason	
29.	Stephen Mukasa Magezi	Driver	
30.	Hillary Mwogeza	Driver	
31.	Sam Muweta	Driver	
32.	Godffey Obbo	Driver	
33.	Richard Jawoko	Driver	
34.	Rogers Kateu	Driver	
35.	Andrew Omunyide	Driver	

36.	Patrick Muledhu	Security guard
37.	Elwaru Shadrack	Security guard
38.	Godffrey Matuga	Security guard
39.	Musanya Ali	Cleaner

NON NARO STAFF AT KAJJANSI

40.	Ochwo Betty	Stores Assistant
41.	Mparampa Amos	Lab. Technician
42.	Kizza Florence	Office Messenger
43.	Ssonko	Driver
44.	Ddumba	Driver